Unauthorized Drug Use in the US Army Based on Medical Review Officer Evaluations

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This article examines the US Army’s Medical Review Officer (MRO) drug positive urinalysis evaluations from 2009 through 2012. We retrospectively analyzed nearly 70,000 MRO results by year, drug and Army component. Of the MRO reviewable positive results, the Army’s unauthorized drug positive rate was 22.21%. The component rates were 20.81, 24.17 and 26.09% for the Active Duty, Reserve and National Guard, respectively. By drug, the average unauthorized rates over these 4 years were 13.78% for oxycodone, 24.62% oxymorphone, 18.56%  d-amphetamine, 98.04%  d-methamphetamine, 21.97% codeine, 45.21% morphine and 100% steroids. In 2012 testing began for hydrocodone and hydromorphone and their unauthorized rates were 12.32 and 15.04%, respectively. The Army’s unauthorized drug positive rate peaked in 2012 when it increased over 44% from the previous year. The 2012 rates in decreasing order were steroids >  d-methamphetamine > morphine > oxyphenone > oxycodone > codeine >  d-amphetamine > hydromorphone > hydrocodone. This comprehensive analysis showed that the majority of the Army’s MRO reviews were associated with the use of authorized prescriptions; however, there appears to be significant abuse of oxycodone and  d-amphetamine.

Introduction

For over 30 years, the Department of Defense (DoD) has conducted urinalysis testing of service members for drugs of abuse in order to maintain a safe, effective and ready military. To support this end goal, the US Army in 2012 submitted over 2.2 million urine specimens for drug analysis to a DoD Forensic Toxicology Drug Testing Laboratory (FTDTL). All specimens were handled under strict chain-of-custody procedures and underwent the same rigorous testing procedures at each of the FTDTLs (1–3). This forensic process was previously described by these authors (4). Similar to the Substance Abuse Mental Health Services Administration (SAMHSA) drug testing rules, for any military drug positive result to be released the urine sample must have tested positive by two different analytical technologies. DoD specimens were initially tested with two separate immunoassays and if presumptively positive then a final confirmation assay utilizing gas chromatography–mass spectrometry (GC–MS) was performed. Prior to each laboratory test, a fresh urine aliquot was poured from the original specimen and after completion of all testing, the results were electronically relayed to the submitting installation via a secure DoD web portal. The DoD cutoff concentrations for each drug test are listed in Table 1.

In order for certain drug positive results to be released to the submitting unit’s command, they are first required to undergo evaluation by a certified Army Medical Review Officer (MRO) who reviews the soldier’s prescription records to determine if there is a valid medical explanation for the positive urinalysis result (5). If there is, the MRO will then document the result as an authorized use and the final drug result will appear as a negative to the submitting unit. This process is essential to prevent any negative stigma for the properly medicated soldier. From 2009 through 2011, drugs requiring an MRO review included oxycodone, oxymorphone, codeine, morphine, steroids and the  d-isomers of amphetamine and methamphetamine. In 2012, hydrocodone and hydromorphone were added to the DoD drug testing panel and required MRO review along with the previously listed drugs. In addition, any other non-Schedule 1 positive drug result can undergo an MRO review at the request of the submitting unit. This has occasionally been done to identify positive marijuana results caused by prescriptions of Dronabinol or Marinol that contain synthetic tetrahydrocannabinol. Similarly, cocaine has occasionally been used in certain facial operations (i.e., dental, ear, nose and throat procedures) because of its vasoconstrictive and local anesthetic properties.

MROs are required to know how the human body metabolizes drugs prior to making their decisions. This is vital for accuracy because the cytochrome P-450 system catalyzes the demethylation of multiple drugs in the DoD test panel. These metabolic reactions include the conversion of codeine to morphine,  d-methamphetamine to  d-amphetamine, hydrocodeine to hydrocodone and oxycodone into oxymorphone. The presence of the drug metabolite with a valid prescription for the parent drug results in an authorized use determination by the MRO. Drug positive DoD civilian specimens undergo an MRO review by non-DoD physicians following guidelines established by SAMHSA (6) and the Army (7).

This paper examines the longitudinal nature of Army MRO evaluations and drug abuse in the overall Army as well as its components. In this 4-year retrospective study, all MRO positive urinalysis evaluations from 2009 through 2012 were categorized as unauthorized, authorized or pending. These data were further refined to represent the three Army components; the Active Duty (AD), Reserve (RES) and National Guard (NG).

Methods

The US Army conducts urinalysis testing on soldiers through a well-defined and long established program (1–3). All specimens are collected, delivered and tested at DoD FTDTLs under strict chain-of-custody procedures described previously (4). All steroid testing was conducted at the University of California Los Angeles Olympic Analytical Laboratory through a DoD contract.

From 2009 to 2012, all Army MROs were required to be physicians and certified by the Army Medical Command Drug Testing Program Office (5). Certification was accomplished by one of two routes: attend an in-person 2-day didactic course or complete a comprehensive online training program. In both, the
A physician was subsequently required to pass a comprehensive examination to earn MRO certification that must be renewed every 3 years.

The Army mandates that all drug positives involving opiates, steroids, d-amphetamine or d-methamphetamine must be assessed by a currently certified Army MRO prior to being released to the submitting unit’s command (5). Upon completing their assessment, MROs have only two options available; either the drug positive urinalysis result is due to an authorized use or it is due to illegitimate, unauthorized use. If the soldier’s medical record contains a recent prescription that could have caused the positive urinalysis result, then the MRO would document an authorized use in the web-based Drug and Alcohol Management Information System. A prescription was deemed authorized if it had been filled within 6 months prior to the date the urinalysis specimen was collected (5). All MRO determinations receive a quality assurance review by senior forensic toxicologists in the Army’s Drug Testing Program Office to ensure accuracy. Incorrect determinations are returned with comments to the MRO for re-evaluation.

Unless stated otherwise, unauthorized drug positive rates are defined as the number of MRO illegitimate drug positive results in a certain time period divided by the total number of completed MRO evaluations multiplied by 100. Percent pending is the number of incomplete MRO evaluations divided by the total number of submitted MRO evaluations. All results are reported as a percentage to the hundredths.

**Results**

In this study, we determined the unauthorized positive rate by drug for all Army urinalyses requiring MRO evaluation from 2009 through 2012. Over these 4 years, there were a total of 65,857 MRO reviews completed and 22.21% were determined to be an unauthorized use of drugs. The 2009–2012 unauthorized rates by component were 20.18, 24.17 and 26.09% for the AD, RES and NG, respectively. The Army’s overall unauthorized drug positive rate dramatically peaked in 2012 increasing by over 40% from the previous year (Figure 1). By component, peak rates occurred in 2012 for the AD, 2009 for the RES and 2010 for the NG. The AD rate nearly doubled from 2011 to 2012, whereas it had been progressively decreasing in previous years. From 2011 to 2012, there was a moderate increase in the RES unauthorized drug rate and a moderate decrease in the NG rate.

From 2009 through 2012, the average unauthorized positive rate by drug was 13.78% oxycodone, 24.62% oxymorphone, 98.04% d-methamphetamine, 15.86% d-amphetamine, 21.97% codeine, 45.21% morphine and 100% for steroids (data not shown). The unauthorized rates by drug and year are shown in Figure 2. Pulse testing for the semi-synthetic opiates hydrocodone and

<table>
<thead>
<tr>
<th>Drug/metabolite</th>
<th>Immunoassay screen (ng/mL)</th>
<th>GC/MS confirmation (ng/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marijuana (THC-acid)</td>
<td>50</td>
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</tr>
<tr>
<td>Cocaine (benzoylecgonine)</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>Amphetamines</td>
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<td>100</td>
</tr>
<tr>
<td>d-Amphetamine</td>
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<td>100</td>
</tr>
<tr>
<td>d-Methamphetamine</td>
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<td>100</td>
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<tr>
<td>Hydrocodone</td>
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<td>100</td>
</tr>
<tr>
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<td>500</td>
</tr>
<tr>
<td>MDMA/MDA</td>
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<td>2,000</td>
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<tr>
<td>Morphine</td>
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</tr>
<tr>
<td>Codeine</td>
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<td></td>
</tr>
<tr>
<td>6-AM</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Oxycodone</td>
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<tr>
<td>Oxymorphone</td>
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<tr>
<td>PCP</td>
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</tbody>
</table>

6-AM, 6-monooctylmorpheine; PCP, phencyclidine.

**Figure 1.** MRO unauthorized use by year. The % unauthorized is defined as the number of MRO evaluated unauthorized drug positives divided by the total number of completed MRO evaluations multiplied by 100.
hydromorphone began in May 2012 for approximately one-third of the specimens received.

In 2012 the total number of Army urinalysis positive specimens requiring MRO evaluation was 20,536 with 57% submitted from the AD, 31% from the NG and 12% from the RES. Relative to 2009, the number of 2012 MRO evaluations nearly doubled with the AD increasing 42%, the NG 152% and the RES 509%. The 2012 MRO unauthorized drug positive rates in decreasing order were steroids > D-methamphetamine > morphine > oxymorphone > oxycodone > codeine > D-amphetamine > hydromorphone > hydrocodone. These data are illustrated in Table II where \( U \) represents the number of unauthorized drug

### Table II

<table>
<thead>
<tr>
<th>Drug</th>
<th>AD</th>
<th>NG</th>
<th>RES</th>
<th>Total</th>
<th>% U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxycodone</td>
<td>1,059</td>
<td>412</td>
<td>158</td>
<td>1,629</td>
<td>33.01</td>
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<td>Oxymorphone</td>
<td>1,478</td>
<td>371</td>
<td>132</td>
<td>1,981</td>
<td>40.14</td>
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<tr>
<td>D-amphetamine</td>
<td>2,808</td>
<td>2,677</td>
<td>811</td>
<td>6,296</td>
<td>28.67</td>
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<td>Morphine</td>
<td>1,485</td>
<td>371</td>
<td>132</td>
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<tr>
<td>Codeine</td>
<td>56</td>
<td>64</td>
<td>56</td>
<td>176</td>
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<tr>
<td>Opiates</td>
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<td>811</td>
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<tr>
<td>Morphine</td>
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<td>371</td>
<td>132</td>
<td>1,988</td>
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<tr>
<td>Hydromorphone</td>
<td>1,092</td>
<td>412</td>
<td>158</td>
<td>1,662</td>
<td>33.01</td>
</tr>
<tr>
<td>Overall</td>
<td>1,478</td>
<td>371</td>
<td>132</td>
<td>1,981</td>
<td>40.14</td>
</tr>
</tbody>
</table>
positives, % $U$ is the unauthorized drug positive rate, $A$ is the number of authorized drug positive results.

In each year, a significant number of evaluations remained in a pending status because the designated MRO did not complete the mandated review. The average pending rate from 2009 to 2012 was 4.96% with the lowest rate of 0.28% occurring in 2009 and the highest at 11.37% in 2012 (data not shown). In 2012 the component pending rates were 2.12% for the AD, 22.06% for the NG and 27.49% for the RES.

The abuse of commonly prescribed opioids has been a major societal concern over the last decade. Reflecting this, the Army began testing urine samples for oxycodone and oxymorphone in 2006 and hydrocodone and hydromorphone in mid-2012. Analysis of the 2009–2012 MRO data shows that the percentage of unauthorized positives for oxycodone has significantly increased (Figure 3). The oxymorphone unauthorized rates are higher still; however, based upon the high volume of oxycodone prescriptions in the DoD, it is likely that the majority are due to oxycodone metabolism. Relative to 2009, the Army’s 2012 unauthorized rate nearly tripled for oxycodone to a high of 27.32% and oxymorphone more than doubled to 32.06%. Each Army component had peak unauthorized rates for these drugs in 2012. From 2009 to 2012, the AD rate nearly tripled while the NG almost doubled and the RES increased about 1.5-fold. The 2012 unauthorized rates for hydrocodone and hydromorphone were significantly less than the oxycodone and oxymorphone rates. They were 12.32% for hydrocodone and 15.04% for hydromorphone with the NG having moderately higher rates than the AD and RES.

The Army’s morphine and codeine unauthorized rates have remained fairly consistent from 2009 through 2012 with the morphine rates being about double that of codeine. The morphine unauthorized rates ranged from a low of 41.54% in 2009 to a high of 47.43% in 2011. The codeine unauthorized rates ranged from a low of 17.76% in 2009 to a high of 23.60% in 2011.

By far the most common positive drug result requiring an MRO evaluation involved d-amphetamine. In 2012 there were 8,042 MRO evaluations of d-amphetamine, 2.5-fold more than oxymorphone the next most common positive drug result requiring review. The d-amphetamine unauthorized rates in the Army ranged from a low of 15.72% in 2011 to a peak of 21.51% in 2012. During this time, the AD unauthorized rate for d-amphetamine nearly doubled while we observed a moderate increase in the RES and a moderate decrease observed in the NG (Figure 4). RES data for d-amphetamine was not collected in 2009.

The d-methamphetamine unauthorized positive rates have always been significantly higher than the d-amphetamine rates. From 2009 through 2012, the Army’s d-methamphetamine rates remained very stable from a low of 97.58% in 2011 to a high of 98.58% in 2010.

Finally, Army MROs are occasionally required to complete reviews for steroids, marijuana and cocaine positive urinalysis results. From 2009 through 2012, there were a total of 120 MRO evaluations involving steroids and all were determined to be unauthorized use of drugs. There has been a steady decrease in the number of steroid MRO reviews in each year from a high of 44 in 2009 to a low of 17 in 2012. During this time span, 19 marijuana positive and 2 cocaine positive urinalyses underwent MRO evaluation and all were determined to be due to an authorized use of a prescribed medication.

**Figure 3.** Oxycodone unauthorized rates from 2009 to 2012. The % unauthorized is defined as the number of MRO evaluated unauthorized drug positives divided by the total number of completed MRO evaluations multiplied by 100.
Discussion

To the best of our knowledge, this paper represents the first published study that focuses on MRO drug review assessments. From 2009 through 2012, the majority of the Army’s drug positive results for oxymorphone, oxycodone, hydrocodone, hydromorphone, codeine and d-amphetamine were caused by authorized prescriptions use based upon a comprehensive review of the MRO results. Inversely, the majority of d-methamphetamine and nearly half of the morphine were due to unauthorized use. The 2012 MRO unauthorized drug positive rates in decreasing order were steroids > d-methamphetamine > morphine > oxymorphone > oxycodone > codeine > d-amphetamine > hydromorphone > hydrocodone. This sequence is notably different from the initial 2009 data which was steroids > d-methamphetamine > morphine > codeine > d-amphetamine > oxymorphone > oxycodone.

Comparing the true unauthorized rates for the Army MRO evaluated drugs against the previously published non-MRO reviewed drug prevalence rates in 2011 highlight the importance of the MRO process. The 2011 pre-MRO evaluation drug positive rates in decreasing order were oxymorphone > oxycodone > marijuana > d-amphetamine > codeine > cocaine > morphine > d-methamphetamine > methylenedioxyamphetamine methamphetamine (MDMA) > heroin > methylenedioxyamphetamine (MDA) > phencyclidine (PCP) (4). After elimination of MRO-determined authorized use positives, the order of the rates became marijuana > oxymorphone > cocaine > d-amphetamine > oxycodone > morphine > d-methamphetamine > codeine > MDMA > heroin > MDA > PCP. This illustrates that marijuana continues to be the most abused drug in the Army as it is in the American general public (8, 9). The post-MRO data also highlight that many soldiers are still abusing cocaine.

From 2009 to 2012, the annual number of Army urinalysis positive results requiring MRO evaluation nearly doubled. This increased workload is not surprising because the number of positive urinanalyses has steadily increased from 2001 to 2011 largely due to the expansion of the force and the additional testing of new drug classes (4). The Army’s overall MRO unauthorized rates were stable from 2009 to 2010 and then decreased in 2011 followed by a sharp increase in 2012. While the average unauthorized rate was 22.21% from 2009 to 2012, the Army’s peak rate of 26.56% occurred in 2012. From 2009 through 2011, the highest MRO unauthorized rates were either in the NG or RES, but in 2012 there was a dramatic shift to the AD. Unexpectedly the AD rate nearly doubled from 2011 to 2012 while previously decreasing from 2009 through 2011. Although a low level of MRO assessments are expected to not be completed, it is discouraging that the RES and NG pending rates are more than 10-fold higher than the AD. This was consistently observed from 2009 through 2012. In order to improve the overall timeliness of reviews, in mid-2013 the Army Drug Testing Program Office expanded MRO duties to clinically oriented non-physicians, specifically to physician assistants, nurse practitioners and PhD forensic toxicologists (5).

The examination of specific drug positive unauthorized rates from 2009 through 2012 illustrates some significant trends. Specifically, the high unauthorized positive rates for oxycodone and its major metabolite oxymorphone as well as d-amphetamine...
are disconcerting. While there appears to be a significant number of soldiers being prescribed oxycodone to treat chronic pain and D-amphetamine (i.e., Adderall) for attention deficit hyperactivity disorder (ADHD), there is also significant unauthorized use.

The abuse of commonly prescribed opioids has been a major societal concern since the start of the twenty-first century. Statistics show that while Americans comprise <5% of the global population, they consume more than 80% of the world’s opioid prescriptions and more than 99% of the hydrocodone (10). In 2010, news reports indicated that US pharmacies dispensed the equivalent of 69 tons of pure oxycodone and 42 tons of pure hydrocodone (11). That is equivalent to providing forty 5-mg oxycodone and twenty-four 5-mg hydrocodone tablets to every person in the USA. A significant amount of these drugs are being diverted since more than five million Americans over 12 years of age admitted to taking prescription pain relievers for reasons other than pain (12).

Because soldiers’ habits typically reflect the drug use patterns of society, the Army began forensically testing urine samples for oxycodone and oxymorphone in 2006 and for hydrocodone and hydromorphone in 2012. The MRO data from 2009 through 2012 show that the percentage of unauthorized positive urinalyses for oxycodone and oxymorphone has significantly increased. Relative to 2009, the Army’s 2012 unauthorized rate nearly tripled for oxycodone and more than doubled for oxymorphone. Each Army component had peak unauthorized rates for these drugs in 2012. This trend correlates well with a recent Institute of Medicine report that stated military physicians in 2009 wrote more than four times the number of pain medication prescriptions than in 2001 (13), even though the size of the force only expanded by ~20%. We previously documented a significant increase in the percentage of oxycodone and oxymorphone (non-MRO reviewed) drug positive urinalyses in each Army component from 2006 to 2011 (4), which is consistent with the American general workforce based upon urinalysis testing done by Quest Diagnostics (9). Their results showed that the oxycodone positive rate increased 10% from 2010 to 2011 and had increased 20% since 2007. Over a 1-year period from August 2011 through July 2012, oxycodone was the third most prescribed medication in the DoD based upon a Pharmacy Database Transaction Services (PDTS) report. Most of the Army’s oxymorphone positive results are likely due to it being a primary metabolite of oxycodone because oxymorphone was the 352nd most prescribed medication of 2,609 drugs listed in the PDTS report. More importantly, the report showed there were 100 times more oxycodone than oxymorphone prescriptions and 271-fold more DoD recipients.

Examining the data by year shows a significant increase in the 2012 oxycodone rates for the AD, which corresponds to December 2011 when the Army FTDTLs began accessing the electronic prescription-review system (ePRS). The FTDTLs are able to essentially perform an electronic MRO evaluation using a secure data connection between the FTDTL test result database and the DoD’s PDTS. Prior to the release of a positive result requiring an MRO evaluation, an electronic query determines whether a valid prescription exists to account for the positive result. In effect this allows virtual MRO evaluations to be conducted without an MRO. This process was first implemented for oxycodone and oxymorphone due to the commercial availability of a highly specific immunoassay for oxycodone. Positive oxycodone and oxymorphone laboratory screening results are now checked against the soldier’s corresponding military medical prescription record thru ePRS to eliminate specimens that screen positive from undergoing a labor-intensive GC–MS confirmation analysis. After implementing this process, we expected the observed increase in the oxycodone post-MRO AD unauthorized rate because the PDTS captures nearly all of the AD prescriptions and only a small minority of those from the NG and RES.

We have concerns about the forensic usefulness of unauthorized oxycodone and oxymorphone positive urinalyses because in our combined experience we have been involved in only one DoD court proceeding involving a positive oxycodone. If soldiers are not being held accountable for these positive opioid urinalyses, we debate the usefulness of their urine being forensically tested as they represent a significant mission increase for the FTDTLs whose resources have not grown in concert with the increased workload. Further, there are many other emerging illicit drugs such as synthetic marijuana or bath salts that we could better commit the limited FTDTL testing resources (14). Without the ability to access the ePRS, both our forensic laboratory workforce and the Army MROs would be overwhelmed.

Pulse testing for hydrocodone and hydromorphone began in May 2012. Data from the last half of 2012 indicates a relatively high positive rate, which reflects hydrocodone being the second most DoD prescribed medication in the PDTS report. The 2012 MRO unauthorized rates for hydrocodone and hydromorphone were 12.32 and 15.04%, respectively, much less than the unauthorized oxycodone and oxymorphone rates. This is possibly due to oxycodone having greater potency than hydrocodone. We assume that the hydromorphone rate is higher than the hydrocodone rate due to it being a major metabolite of the latter as it is prescribed far less often. The PDTS report lists hydromorphone as the 474th most prescribed medication in the DoD and there were 265 times more hydrocodone prescriptions than hydromorphone.

While the unauthorized positive rate for morphine is high, the actual number of users detected is low due to the FTDTLs pulse testing ~20% of samples for this drug. The morphine unauthorized positive rate has remained stable from 2009 through 2012 while the AD non-MRO drug positive rates progressively increased 7-fold from 2001 to 2011 (4). In late 2013, morphine testing became required for all specimens, which will allow us to better determine if its abuse is a significant issue. It is likely that some of these positive results are due to heroin abuse. The Army’s drug positive rate for heroin has increased 7-fold from 2005 to 2011 but remains <0.01% (4). Because heroin is rapidly deacetylated in vivo to morphine, its use could result in an unauthorized morphine positive result and a negative heroin result (15, 16).

The MRO unauthorized positive rates in the amphetamine drug class were higher than anticipated. From 2009 to 2012, the Army’s average D-amphetamine unauthorized rate was 18.56% while the D-methamphetamine rate was 98.04%. By far the most common positive drug result requiring an MRO evaluation was D-amphetamine. In 2012 there were over two times more D-amphetamine MRO evaluations than the next most common drug, oxymorphone. The D-amphetamine unauthorized rates in the Army ranged from a low of 15.72% in 2011 to a peak of 21.51% in 2012. From 2011 to 2012, the D-amphetamine
authorized rate in the AD nearly doubled. This correlates with the non-MRO reviewed drug prevalence data where the d-amphetamine positive rate steadily increased from 2006, when d-isomer specific testing began, to 2011 (4). Over these 6 years, the AD positive rate increased nearly 5-fold while the NG and RES increased over 3-fold. Similar to the general public, the high d-amphetamine unauthorized rates likely reflect Adderall being commonly prescribed to treat ADHD and its subsequent diversion. A 2008 national survey of US high school seniors found that nearly 3% had used Adderall without a prescription (17). In the PDTS report, d-amphetamine was the 63rd most prescribed medication. With the recent commercial availability of a d-methamphetamine-specific immunoassay kit, the FTDTLs can soon begin to utilize the ePRS to conduct initial MRO assessments to quickly eliminate from testing those soldiers with an authorized d-amphetamine prescription. Similar to oxycodone and oxymorphone, it is critical for the laboratories to utilize this electronic tool as they have limited resources available to conduct drug testing.

The d-methamphetamine unauthorized positive rates have been consistently much higher than the d-amphetamine rates. From 2009 through 2012, the Army’s d-methamphetamine rates remained very stable. This was not unexpected as prescriptions for d-methamphetamine are rare. In the 2012 PDTS report, there were only 12 prescriptions for d-methamphetamine dispensed to three service members.

To the best of our knowledge, these findings represent the first published MRO data and this study expands the current body of knowledge about Army drug abuse. The MRO program serves as a vital deterrent to prevent soldiers from unfairly receiving a positive urine result and its associated negative stigma. It has also more clearly identified drug abusers so their command can take appropriate corrective action. The Army's mission readiness will continue to benefit from having soldiers fit for duty and free from drug abuse.

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References